FUELS SUPPLY

Submission of

ONTARIO HYDRO

to the

Royal Commission

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8.0 FUELS SUPPLY

8.1 FUEL REQUIREMENTS

8.1.1 Introduction

This section deals primarily with the requirements of Ontario Hydro's East and West Systems for fossil and nuclear fuels, and the factors that enter into the establishment of an economic and responsive fuels supply program. The various illustrative tables included in this section are based where relevant on Ontario Hydro's Generation Development Program as of September 1975. This program was then considered to be the most probable of the many possible future programs. It was based on meeting the most probable future loads that were forecast in 1975; and it included a relatively high rate of development of nuclear capacity.

The September 1975 program and the 1975 load forecast have been superseded by more up-to-date plans, but complete data on the latter were not available at the time this memorandum was prepared. However, the general trends and the adaptability of the fuels supply program herein illustrated have been evolved to be consistent with the changing requirements of updated load forecasts and modified generation schedules.

8.1.2 Strategy

The development of an optimal fuels supply program is made complex by the need to meet multiple objectives and constraints. Factors considered include feasibility, fuel quality, security of supply, cost, and flexibility in quantities deliverable. Related environmental considerations and conservation of non-renewable resources help shape the evolving structure of a viable and responsive fuels program.

Three principal elements that result from current evaluations of planned future fuel needs as well as the considerations noted above are:

(a) Because of their relative scarcity and cost, oil and gas will not be proposed as the primary fuels for use in new fossil-steam generation developed after completion of the oil-fired station at Lennox GS and the proposed oil-fired generating station at Wesleyville.

(b) The use of coal for additional generation is planned, but on a limited basis, because of concerns related to coal supply expansion, security, increasing costs, and air quality.

(c) Primary fuel reliance planning for the future is based on indigenous supplies of uranium, provided that capital requirements for new nuclear generating stations can be met.

8.1.3 Future Requirements

The forecast of annual fuel usage is given in Figure 8.1-1. The quantities of uranium and coal required expand throughout the forecast period.

Insofar as residual oil and natural gas are concerned, the forecast usage stabilizes in the 1980s, thus limiting the demands of the power system on these relatively scarce resources.

Figure 8.1-2 provides a forecast of energy distributions by source: fossil fuel, uranium, hydraulic generation and purchased electricity. The distribution is expressed in electrical units of energy. Figure 8.1-3 provides a similar forecast of energy distribution by source, but expressed in relative percentages. Both figures are consistent with earlier Figure 8.1-1.

Both tables reflect Ontario Hydro's present plans to have uranium and coal become the preponderant sources of its electrical output, providing by 1990 some 82% of the total energy. Residual oil would account for only 3% and natural gas only 2% of the output forecast for 1990.

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FIGURE 8.1-1

Forecast of Ontario Hydro's Annual Fuel Usage
1975-1995

Year	Coal Million U.S. Tons Equivalent	Residual Oil Million Bbl	Natural Gas Bcf	Other Oil Million Bbl	Uranium Mg
1975	7.6	1.3	55.7	0.05	253
1980	16.5	13.7	49.	0.09	758
1985	17.5	12.9	49.	0.31	1717
1990	21.7	10.5	49.	0.38	2917
1995	28.7	10.0	49.	0.56	4484

Notes

1. Fuel usage refers to the fuel inputs to the power system to meet electrical demands. 1975 and 1980 include both Ontario and export demands. 1985, 1990, and 1995 include primary demand only.

2. Forecast is based on Generation Development Program of September 1975 (LRF43P) and the 1975 Load Forecast.

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FIGURE 8.1-2

Forecast Distribution of
Ontario Hydro's Annual Energy Production in Gwh

Year	Coal	Residual Oil	Natural Gas	Other Oil	Uranium	Hydraulic	Electricity Purchases	Total
1975	20,708	709	5,229	15	11,611	34,745	14,874	87,8
1980	45,687	8,165	4,675	30	38,183	34,745	4,100	135,5
1985	49,508	8,535	4,597	115	87,032	34,598	0	184,385
1990	61,442	6,830	4,597	145	147,728	34,598	0	255,3
1995	73,854	6,410	4,597	215	226,972	34,598	0	346,646

Notes

1. Uranium includes that used to produce the energy purchased from AECL's Douglas Point GS, and uranium used to supply steam to the Bruce Heavy Water Production Plants.

2. Forecast is based on Generation Development Program of September 1975 (LRF43P) and the 1975 Load Forecast.

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FIGURE 8.1-3

Forecast Distribution of
Ontario Hydro's Annual Energy Production in %

Year	Coal	Residual Oil	Natural Gas	Uranium	Hydraulic	Electricity Purchases	Total
1975	24	1	6	13	39	17	100
1980	34	6	3	28	26	3	100
1985	27	5	2	47	19	0	100
1990	24	3	2	58	13	0	100
1995	21	2	1	66	10	0	100

Notes

1. Data above are based on Figure 8.1-2.

2. Figures are rounded off to the nearest whole number.

8.2 SOURCES OF FUEL

8.2.1 Coal

Ontario Hydro has long-term contracts with United States coal suppliers in Pennsylvania and West Virginia. At present, Ontario Hydro has under contract a nominal 10,250,000 tons per year as shown below.

U.S. Tons Per Year		Expiry Date
6,000,000	Consolidation Coal Company	1986
2,500,000	Eastern Associated Coal Corporation	1984
1,750,000	Various Companies	1979-80

It is expected that most of these contracts will be renewed or replaced as they expire.

Deliveries of coal, under a further contract with the United States Steel Corporation, are scheduled to begin in late 1976 and should reach a rate of about 3 million tons per year by 1979. This contract will provide a total of 90 million tons of coal over a thirty year period. (1)

Consumption of Western Canadian bituminous coal is expected to be about 4.0 to 6.0 million tons per year by 1980. Ontario Hydro is currently assessing likely sources and is contracting with potential suppliers, subject to governmental approvals. (2,3)

In addition to the bituminous coal, Ontario Hydro plans to use smaller quantities of sub-bituminous coal and lignite from Western Canada. These coals will largely be used for new generating stations specifically designed to use such coals as the primary fuel.

Ontario's coal resource is the Onakawana lignite deposit in Northern Ontario, with proven reserves estimated at up to 200 million tons. If and when developed for power generation, these reserves could

provide for a relatively small increment of Ontario's electricity requirements.

Eastern Canada is not considered a significant source of future coal supplies because at present supplies are very limited and there is no assurance of supplies in the long-term.

Offshore coal represents a possible source, but does not appear at this time to be competitive in cost with United States coal nor comparable in security with Canadian coal.

8.2.2 Oil

Ontario Hydro has contracted with Golden Eagle's refinery near Quebec City utilizing Venezuelan and Middle Eastern crude for a supply of residual fuel oil. The contract, for a nominal 5 million barrels of oil per year, expires in 1979. In addition to the supply of residual oil originating from foreign crude, Ontario Hydro and Petrosar Limited of Sarnia, Ontario have exchanged letters confirming arrangements whereby Petrosar Limited is to supply 7.3 million barrels per year of low-sulphur residual fuel oil using Western Canadian crude oil as the feedstock. The supply contract would extend for 15 years from 1977 through 1991 and be renewable for 3-year periods thereafter.

8.2.3 Natural Gas

Ontario Hydro has a contract with Consumers' Gas Limited for the supply of a nominal 49 billion cubic feet of natural gas per year until November 1981. It is presently used at the Richard L. Hearn generating station, in Metropolitan Toronto, which has four 100 MW units fuelled solely with gas and four 200 MW units which can be fuelled with gas or coal.

It is anticipated that supplies of Arctic gas are likely to become available by the mid 1980's, thus offsetting anticipated declines in the movement of Alberta gas supplies to Ontario.

8.2.4 Uranium

Canada has large resources of uranium currently estimated by the Federal Government (4) at 400,000 megagrams, and a large portion of these reserves are

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in Ontario. Of these resources, sufficient has been set aside for Canadian use to provide 30 years' operating life for Canadian stations in operation, stations under construction and committed, and those planned to be committed through 1985. A key factor that must be considered is the rate at which production capability can be developed on these resources and supported by them. This matter is dealt with later in Section 8.4.5.

During the next ten years, Ontario Hydro's present plans are to increase its installed nuclear capacity substantially, with a resultant increase in the requirements for nuclear fuel. Existing contracts will meet almost all of Ontario Hydro's requirements for the period 1976-1979 and part of its needs through to 1985. From 1975 to 1979 deliveries will total 2,708 megagrams of uranium, and from 1980 to 1985 deliveries covered by current agreements total 3,920 megagrams of uranium. Over the past two years Ontario Hydro has been negotiating contract terms with Canadian producers for additional supplies.

8.2.5 Plutonium

Plutonium if and when required for advanced nuclear fuel cycles is expected to be available through re-cycling of spent fuel from Ontario Hydro's reactors.

8.2.6 Thorium

Thorium has potential future use as a nuclear fuel in Candu reactors. Canada's resources are conservatively estimated by the Federal Government to exceed 80,000 megagrams of thorium, and appear adequate to meet Canada's potential requirements over any reasonable planning horizon. (5)

8.3 TRANSPORTATION LOGISTICS

8.3.1 Coal

At present, virtually all coal comes from the United States and is transported by unit trains throughout the year to terminals at Conneaut and Ashtabula on the south shore of Lake Erie. During the lake shipping season, this coal is moved by self-unloading lake

boats to stockpiles at Ontario Hydro's coal-fired stations. (6)

Planned coal supplies from Western Canada will be moved by unit trains to generating stations under construction at Thunder Bay and planned at Marmion Lake in Northwestern Ontario. Bituminous coal from Alberta and British Columbia destined for use at existing stations in Southern Ontario will be moved by unit train to a terminal at Thunder Bay, and trans-shipped by lake ships.

Because shipping is shut down during the winter, the non-shipping period being approximately December 31 to April 1, the stockpiles at the generating stations must provide for forecast usage during the winter period as well as possible increases beyond this due to such conditions as increased power demands, reduced generation at other types of stations due to outages, and delays in the start of coal shipments due to weather or strikes.

Transportation by rail and ship to Southern Ontario stations is more economic than rail alone whether the coal comes from Western Canada or the United States. Consideration has also been given to the use of slurry pipelines to transport Western Canadian coal but these do not appear economic at throughputs of less than ten million tons per year.

Technological developments such as various processes of coal gasification, solvent refining, and coal liquefaction could change transportation logistics, but these are not expected to have any substantial effect on planning before the 1980's.

8.3.2 Oil

Currently, residual oil is moved by rail from the Golden Eagle refinery near Quebec City and the same mode may apply to shipments from Petrosar in Sarnia. However, other alternatives are under active study including the use of lake tankers, pipelines and interconnections with the Interprovincial Pipeline, both for residual oil and for crude. Transportation logistics must be able to accommodate a wide range of throughputs since oil usage under contingency conditions can, for an extended period, be two or three times normal usage. Thus, to assist in meeting

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sustained high output requirements as well as for normal operating reasons, substantial oil storage is provided at oil-fired generating stations.

8.3.3 Natural Gas

Gas supply is delivered to the Hearn Generating Station by a special connection to the Consumers' Gas system which in turn is supplied by the TransCanada PipeLines system. Since all the natural gas used is produced within Canada and will be moved by pipeline, no alternative transportation mode is under consideration. Consumers' Gas has substantial underground gas storage in Ontario, and Ontario Hydro's consumption pattern meshes well with Consumers' storage, security and operating needs.

8.3.4 Uranium

Since the physical quantities of uranium fuel are relatively small, transportation logistics are not significant. However, the processing and manufacturing operations involve several months' lead time from production of yellowcake (U_3O_8) at the mine to final delivery of fuel bundles. A backup reserve of finished fuel bundles is maintained to provide operational flexibility as well as security of fuel supply for the nuclear stations.

8.4 SECURITY OF SUPPLY

8.4.1 Structural Changes

Until recently the required security of supply of fuels could be adequately assured by entering into contracts for the necessary quantities with established commercial suppliers. However, with the changes that have occurred in the fuel industry in the past two years, the options open to fuel consumers within the existing market structure have altered greatly. Increasing intervention by domestic and foreign governments in the control of fuel resources has severely limited the ability of commercial suppliers to make long-term commitments. Also, with the development of different policies in various jurisdictions (provincial, federal, foreign) and with increasing inter-jurisdictional disputes on resource regulations, prudence dictates that security

considerations weigh heavily in developing a fuels supply program.

These structural changes in access to fuel supplies have created the need for new approaches in ensuring fuel supply, not only for Ontario Hydro's existing generating stations with operating lives expected to extend over 30 to 40 years, but also for future stations.

Figure 8.4-1 illustrates the relative dependence of Ontario's power system on Canadian and foreign resources of energy and fuel. The proportion of Ontario's electricity supply relying on Canadian resources was 63% in 1970, 71% in 1975, and is forecast at about 72% in 1980 and over 82% in 1990.

Security is sought in a number of ways, including diversity of fuel sources, contractual arrangements with well-established and responsible suppliers to ensure adequate fuel reserves and production capabilities, reliance on Canadian resources where feasible, and diversity of fuels. Security of fuel supplies is linked as well to overall system planning policies which can affect fuels security through the choice of system generation facilities, i.e., nuclear stations vs coal-fired stations.

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FIGURE 8.4-1

Sources of Energy
for Ontario Hydro's Generation of Electricity,
Expressed As Percentages of Total Ontario Hydro Demand

	Generated in Ontario from						Electricity Purchased from		
		Canadian			Residual	U.S.			
Year	Water	Coal	Gas	Uranium	Oil	Coal	Que.	Man.	U.S.
1920	100	0	0	0	0	0	0	0	0
1925	100						0		
1930	86						14		
1935	72						28		
1940	73						27		
1945	72						28		
1950	72						28		
1955	85	0	0	0	0	2	13	0	0
1960	82	1	0	0	0	4	13	0	1
1965	63	3	0	0	0	19	9	0	6
1970	53	0	0	1	0	33	8	1	4
1975	39	0	6	13	1	24	11	2	4
1980	26	9	3	28	6	25	3	0	0
1985	19	8	2	47	5	19	0	0	0
1990	13	9	2	58	3	15	0	0	0
1995	10	11	1	66	2	11	0	0	0

Notes

1. Figures are rounded off to the nearest whole number.

2. In 1970, domestic sources totalled 63% with foreign imports comprising 33% U.S. coal and 4% U.S. electricity.

   In 1975, domestic sources totalled 71% with foreign imports comprising 24% U.S. coal, 1% residual oil and 4% U.S. electricity.

   In 1980, domestic sources are forecast to total about 72% with foreign imports comprising 25% U.S. coal and about 3% residual oil.

   In 1990, domestic sources are forecast to total over 82% with foreign imports comprising 15% U.S. coal and less than 3% residual oil.

3. Residual oil above includes that derived from both domestic and foreign crude oil.

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8.4.2 Coal

Reliability of supply of existing U.S. coal supplies is considered good, but can be influenced by various considerations including the ability of U.S. mines to produce sufficient volumes of coal to meet both domestic and export demands. It is not planned at this time to base new generation on additional long-term U.S. coal supplies prior to the mid-1980's. This is because of the expected increases in U.S. demand for its own coal as U.S. utilities switch from oil and gas to coal, of the associated sensitivity to increased exports, and of U.S. concern for security of supply in their own country.

Arrangements are in progress to develop a long-term Western Canadian coal supply to supplement U.S. deliveries. Experience gained during recent test programs has confirmed the technical, economic and environmental constraints associated with Western Canadian coal. Once agreements for Western Canadian coal have been signed and experience gained on the production and logistic systems, the long-term reliability of supply should be excellent. Short-term interruptions of supply as a result of operational problems could still develop as with other fuel sources.

8.4.3 Oil

The supply reliability of residual oil tends to be better than that of crude oil because of the greater demand for other crude oil fractions used in transportation and as petro-chemical feedstock.

Currently, Hydro's oil supply program envisages primary reliance for residual oil on an Ontario refinery (Petrosar) supplied with crude from Western Canada, and a Quebec refinery (Golden Eagle) supplied with foreign crude. Spot purchases of residual oil, or crude if necessary, can provide additional supplies. Both oil-fired stations, Lennox GS with two of its four units already in service and the proposed Wesleyville GS, have been designed to store and use either residual or crude.

The long-term availability of oil is dependent on both development of additional domestic sources and on continuing imports from foreign producing countries.

By the early 1980's, projections developed by the National Energy Board (7) and reproduced in Figure 8.4-2 show a net imbalance between domestic production of and demand for indigenous feedstocks, thus increasing Canada's dependence on imports.

Should oil shortages develop, it is National Energy Board policy that Canadian consumers will take precedence over export commitments for domestically produced and/or refined oil. However, reliability of supply of domestically produced oils will depend, over the long-term, on the actions of governments in encouraging the development of additional sources of oil (either frontier oil or the tar sands).

Reliability of supply of offshore oil will be dependent on the policies of the governments of producing countries. At the moment, the marketing structure is such that no assurances can be given for long-term supplies. However, total interruptions of foreign oil supplies if they were to occur would most likely be of relatively short duration. Limited cutbacks of foreign supplies are more likely than total interruptions and these limited cutbacks could be maintained for extended periods.

8.4.4 Natural Gas

Because of the low priority for the use of gas as a boiler fuel, potential shortages at least into the 1980's, andd the politically sensitive nature of supplies, natural gas is not currently being considered by Ontario Hydro as a primary fuel for new generation. Natural gas has, however, a role as a supplementary fuel to help maintain air quality at coal-fired stations in metropolitan areas. Ontario Hydro thus has a firm contract providing for the supply of 49 Bcf per year up to November 1981.

Development of Arctic gas reserves and construction of a pipeline from the Mackenzie delta in the mid 1980's and similar development of Polar gas would help ensure the continued availability of the gas supply. Projections of natural gas supply and demand by the National Energy Board (8), reproduced in Figure 8.4-3, indicate an increasing shortfall in meeting total demand until frontier gas is brought to market.

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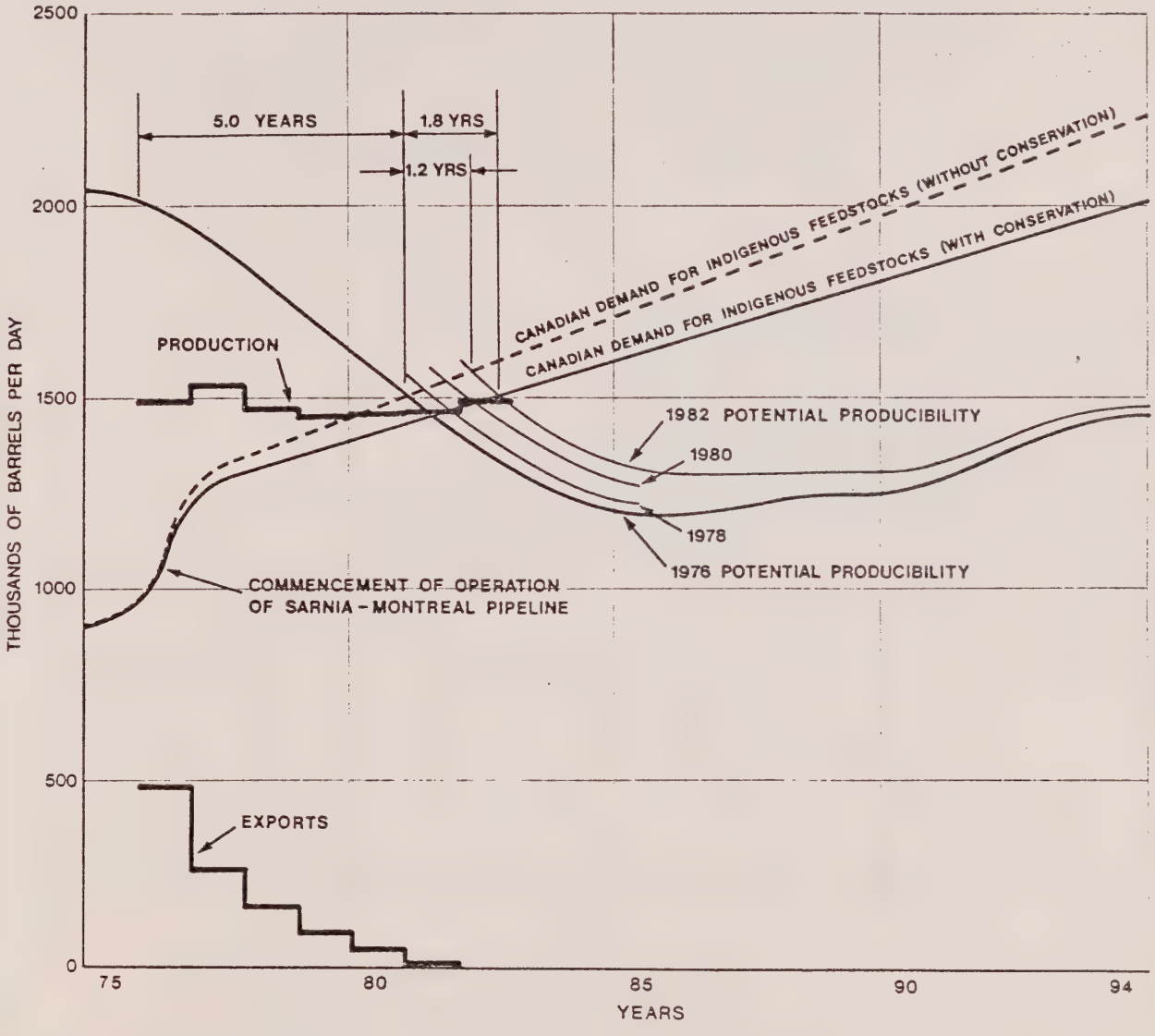
ESTIMATED CANADIAN PRODUCIBILITY AND DEMAND FOR CRUDE OIL



Source: Canadian Natural Gas, Supply and Requirements, National Energy Board, September 1975.

FIGURE 8.4-2

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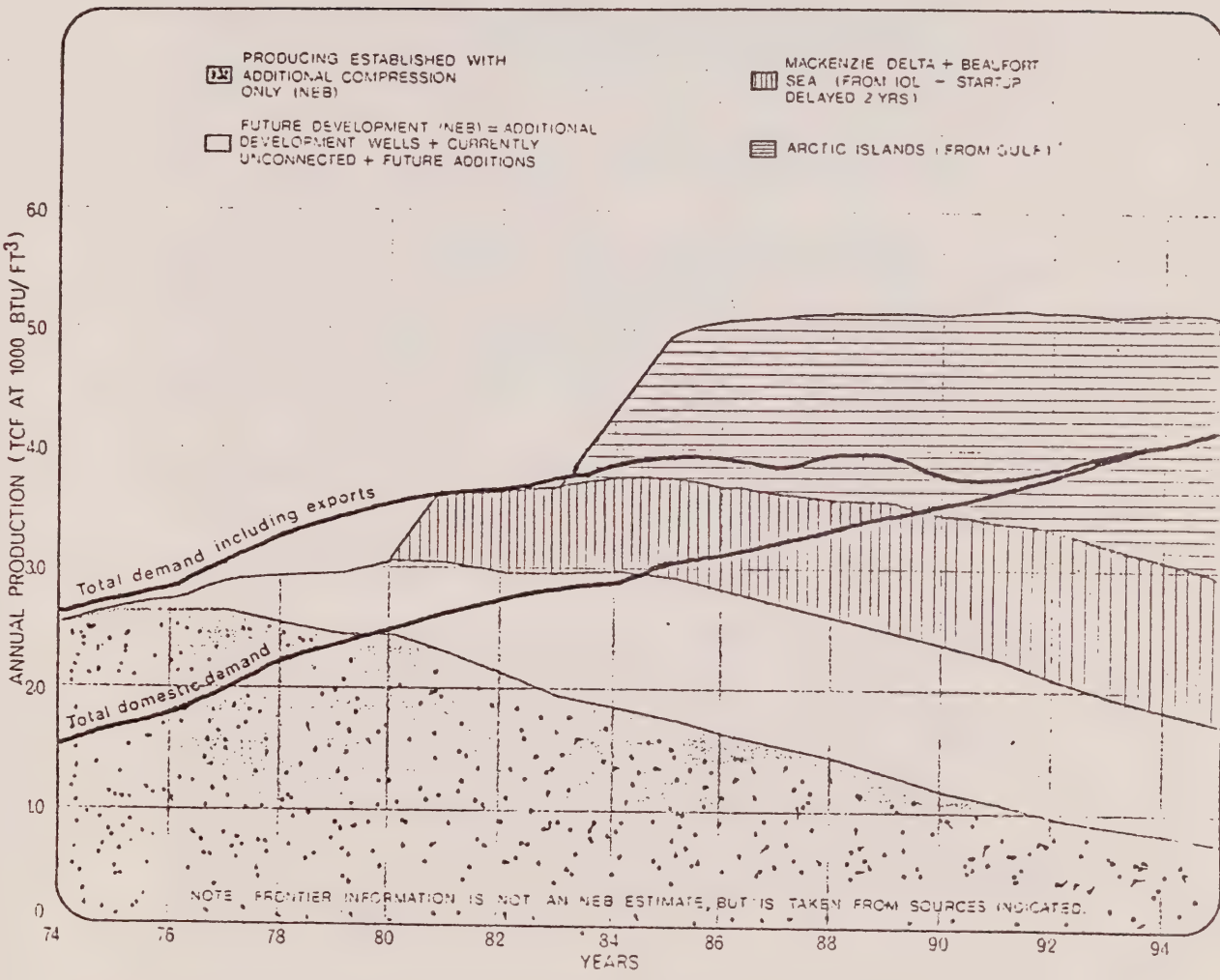
CANADIAN NATURAL GAS SUPPLY AND DEMAND



Source: Canadian Natural Gas, Supply and Requirements, National Energy Board, April 1975.

FIGURE 8.4-3

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8.4.5 Uranium

Of the several fuels, uranium is the only one which is present in Ontario in quantities large enough to meet a substantial portion of Ontario Hydro's fuel requirements for an extended period.

Federal regulations require that Canadian uranium resources be set aside to provide for Canadian nuclear stations in operation, stations under construction and committed, and those planned to be committed within ten years, all for an operating life of thirty years. Also, Federal regulations require Canadian utilities to contract for fifteen years' uranium supply for those stations operating and committed. (9)

However, the forecast demand for uranium both in Canada and on a world scale appears to greatly exceed estimated production capabilities in the long-term. (10) Sufficient domestic uranium resources and projected production capability are available to meet Ontario's power system requirements for an extended period, for example, the forecast needs of Pickering A and B, Bruce A and B and Darlington over their estimated operating lives. For new stations which may come into service after 1990, and which would require commitment some twelve years prior to their in-service dates, there is a need to develop additional production capability from new uranium finds.

In this situation, and since exploration activity in Canada has been at a relatively low level, Ontario Hydro has deemed it advisable to participate financially in uranium exploration programs with experienced resource companies (e.g., Shell Canada, Amok Ltd.) in the hope of stimulating expanded exploration by all interests. (11) New Canadian uranium finds would provide further security in meeting uranium needs over the long-term. Production from new finds will be delayed by extended lead times of 8 to 12 years between exploration find and the start of production.

Present plans call for most of Hydro's future load growth to be supplied from nuclear power generation. Thus the importance of uranium as Hydro's major fuel resource in the long run makes it necessary to secure

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access to substantial uranium deposits in Canada with production potentials extending into the 21st century.

8.5 FLEXIBILITY

Flexibility in fuel supply arrangements must be provided to mesh with the fact that actual usage does not usually match forecast usage. Thus, the fuel supply program must include flexibility provisions to permit increasing or decreasing fuel deliveries from forecast levels.

The absolute amounts of fuel actually required as well as the relative mix of fuels is affected by many developments and contingencies. These include year-to-year and long-term deviations of the actual loads from the loads forecast, changes in system generation expansion programs, reductions in generation due to station outages, variability in hydraulic resources, variability in purchases and sales of electricity, power transmission limitations, variations in station performance, fuels availability and logistic problems, and other factors. Thus, the development of an adequate fuels supply program is not simply to arrange for the supply of fixed quantities of fuel to meet forecast requirements but also to provide a high degree of flexibility in the actual quantities delivered so that they can match changing needs.

Flexibility is provided through the use of stockpiles (coal, oil, uranium), through contracts with provision for reducing or increasing deliveries, through short-term or spot purchases, through sales of surplus fuel, through fuel substitution (i.e., running an oil-fired station instead of a coal-fired station), and through a mix of fuel supply contracts with different termination dates.

8.6 FUEL QUALITY

8.6.1 Quality Elements

Fuel quality here encompasses three elements:

(i) operating suitability for use in Ontario Hydro's generating stations;

(ii) effects on the environment related to the use of fuel;

(iii) effect of quality requirements on cost of fuel.

8.6.2 Coal

Ontario Hydro's existing coal-fired stations were designed to burn high-BTU, medium - sulphur, high-volatile coals from Ohio, Pennsylvania and West Virginia. Use of other types of coal can lower station output, reduce operator and equipment safety, and adversely affect air quality. Thus coal for these stations must meet fairly precise specifications to be acceptable. In order to be able to burn Western Canadian coal successfully in existing stations, it is planned to blend it with U.S. coal.

New stations can be designed to burn Western Canadian coal alone, and such stations are under construction at Thunder Bay and proposed at Marmion Lake in Northwestern Ontario.

8.6.3 Residual Oil

Residual oil supply must meet operating specifications as well as meet sulphur content limits for environmental reasons that can vary from station to station, and that can vary with time depending on station output and weather conditions. Thus the basic long-term supply of residual oil is specified to have a low sulphur content (less than 1%). This permits blending with medium sulphur oils. The cost of low sulphur oil is in general above that for oil with higher levels of sulphur, and the blended oil can be burned without exceeding air quality guidelines.

8.6.4 Natural Gas

Gas delivered to Ontario presents no quality problems from an operating standpoint, or with respect to sulphur or particulate emissions. It is however a premium fuel which over any extended period will likely be more expensive than coal or oil.

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8.6.5 Uranium

Fuel bundles containing uranium are a manufactured product meeting specific Ontario Hydro requirements.

8.7 ENVIRONMENTAL CONSIDERATIONS

8.7.1 Fuel Characteristics

Fuel characteristics are only one element in determining the effect of generating stations on the environment. Station location, station design, weather conditions and operating procedures are factors as well. However, fuel characteristics are important, and in particular the sulphur and ash content of fuels provides a major indication of potential levels of air pollution.

Ontario Hydro's proposed generation program provides for a mix of different fuels to be used in producing electricity. The total fuel quantities, the relative proportions of the different fuels and their properties change over the forecast period. All of these factors affect the absolute and relative sulphur content of the fuels supplied.

8.7.2 Sulphur Content of Fuels

Figure 8.7-1 illustrates trends in sulphur content of Ontario Hydro's fossil fuels, actual in 1970, and forecast to 1995. In this table, residual oil and natural gas are included as equivalent tons of U.S. coal. Figure 8.7-1 shows the following trend. From 1970 to 1995, the fossil fuel consumed increases four-fold but the total sulphur content increases only two-fold. The sulphur proportion of fossil fuels reduces from 2.5% to 1.3%. (12)

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FIGURE 8.7-1

Estimated Sulphur Content of Ontario Hydro's Fossil Fuels

Year	Equivalent U.S. Coal Consumed Million Tons	Sulphur Content Million Tons	Sulphur Content %
1970	8.5	0.213	2.5
1975	10.0	0.200	2.0
1980	21.6	0.342	1.6
1985	22.4	0.345	1.5
1990	26.0	0.394	1.5
1995	32.9	0.428	1.3

Note

1. Data are based on Figure 8.1-1.

2. Residual oil and natural gas have been converted into equivalent tons of coal using Btu content as a basis.

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The effective reduction in the proportion of sulphur content would be shown as greater if allowance were made for the effect of the nuclear generation program in limiting the total consumption of fossil fuels, and thereby limiting the emission of sulphur and particulates. If coal-fired capacity were to be substituted for existing and planned nuclear capacity, emissions from fossil fuel stations could have been projected as approximately 40% greater in 1975 and 200% greater by 1990 than under present planned programs.

The following list notes some of the measures being taken by Ontario Hydro to directly or indirectly reduce sulphur content of fuels or to reduce ground level concentrations:

- Purchases of low-sulphur U.S. coal, e.g., U.S. Steel coal with 1.7 to 1.8% sulphur.

- Utilization of natural gas at Hearn GS.

- Long-term arrangements for low-sulphur residual oil.

- Development of the Western Canadian coal supply program.

8.7.3 Engineering Measures

Related design and operating policies and practices which help maintain air quality include:

- Installation of high stacks and precipitators at fossil-fired thermal stations.

- Use of pollution potential forecasts in operating system generation to reduce concentrations of pollutants.

8.8 CONSERVATION ASPECTS

8.8.1 Constraints and Factors

Ontario Hydro, as a producer of electrical energy, is deeply concerned about the continuing availability of all forms of energy and subscribes fully to the need for conservation. Conservation programs should affect

the selection, supply and use of primary fuels for the electric power system. For this to be effective, it is necessary to have a clear understanding of the overall aim of the conservation program, and the part that electric energy production should play in it.

Some constraints and factors affecting the conservation aspects of potential fuels supply programs are:

(a) Fuel requirements for existing generating stations

(b) Present and projected environmental targets

(c) Availability of fuels

(d) Security and deliverability of fuel supplies

(e) Level of flexibility necessary to respond to changes in fuel supply and demands

(f) Cost considerations

(g) Generating unit availabilities and system transmission capabilities.

Two areas in which Ontario Hydro's program conserves fossil fuels are noted below.

8.8.2 Nuclear-Based Generation

Ontario Hydro's proposed commitment to the CANDU nuclear system, to the extent that about two-thirds of future thermal generating capacity is proposed to be nuclear with the balance coal-fired is an important form of fossil fuel conservation. If the power system had no nuclear stations and all other constraints remained the same, then by 1990 in order to meet the forecast demand, Ontario Hydro would have had to install additional fossil-fired generation which would consume the fossil-fuel equivalent of 53.7 million tons of coal per year. Figure 8.8-1 illustrates this point.

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FIGURE 8.8-1

Projected Usage of Fuels

Year	Thermal Energy Generated Gwh	Millions of Tons of Equivalent U.S. Coal			
		Coal	Natural Gas	Residual Oil	Uranium
1970	23,385	8.5	-	-	0.3
1975	38,257	7.6	2.1	0.3	4.2
1980	96,740	16.5	1.9	3.2	13.9
1985	149,787	17.5	1.9	3.0	31.6
1990	220,742	21.7	1.9	2.5	53.7
1995	312,048	28.7	1.9	2.3	82.5

Note

1. Data are based on Figures 8.1-1 and 8.1-2.

2. In the above table, the expected annual usage of the various fossil and nuclear fuels are expressed in equivalent tons of U.S. coal.

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8.8.3 Generation Based on Oil and Gas

In order to maintain flexibility to react to potential changes and to meet environmental guidelines, Ontario will have a continuing need for oil and natural gas. Nevertheless, because of their relative scarcity and cost, the joint contribution of oil and gas to system generation is not planned to increase. Figure 8.1-2 shows that it declines from 12,800 GWh in 1980 to 11,600 GWh in 1990 despite system expansion. Furthermore, residual oil rather than crude oil will generally be used in the power system to conserve the light and middle fractions of crude which are valuable for other uses.

8.9 COST FACTORS

8.9.1 Methodology

The methodology of developing expected fuel costs is covered in the memorandum on Economic and Financial Factors contained in Exhibit 7. However, it should be emphasized that in the period under consideration, i.e., beyond 1982, fuel cost projections should be viewed with caution. This is because the primary fuel industry is fraught with uncertainties, many of which are politically induced. Any projection, even in a short-term forecast, can be rendered obsolete by political decisions.

Figure 8.9-1 provides a projection of possible fuel cost trends, but these are subject to the uncertainties noted above. These projections suggest that uranium and coal are likely to improve their cost advantage over oil and gas. This factor together with their greater availability will probably maintain their preferred rank for power generation.

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FIGURE 8.9-1

Ontario Hydro Fuel Cost Trends
Expressed in Equivalent Thermal Units

Year	Coal	Residual Oil	Natural Gas	Reactor Fuel
1970	112	-	-	23
1975	350	400	300	30
1980	570	1060	820	50
1985	800	1450	1150	80
1990	1050	1900	1500	110
1995	1350	2500	1950	140

Notes

1. Coal costs in 1967 have been used as a base index set at 100.
2. Forecast figures are based on estimates prepared in June 1975.

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8.9.2 Security and Flexibility - Effect on Fuel Cost

For security, economic and other reasons, it is generally Ontario Hydro's preference to establish medium to long-term contracts (five years or longer) for most of its fuel supply. To a degree, this procedure insulates Ontario Hydro from severe fluctuations in the price of fuels.

However, in order to maintain an adequate level of flexibility to meet changing demands for fuel, spot purchases and short-term contracts are also made as required.

A program for a coal supply from Western Canada initially approximating about 3 to 4 million tons is being established, including mining, railway, terminal, shipping and other arrangements. This development will enhance security, but at a delivered fuel cost some fifty per cent greater than the cost of contract coal delivered from the U.S.

Since the power system has a mix of generating stations (nuclear, coal, oil, gas, hydraulic, etc.) with different efficiencies, and these stations are interconnected both within Ontario and with adjacent utilities there is an inherent opportunity to minimize total system fuel costs by judicious selections of station outputs and fuels choices as well as by appropriate sales and purchases of fuels and electricity. These opportunities are taken whenever feasible as a normal part of operating and procurement practice.

8.9.3 Environmental Regulations - Effect on Fuel Cost

Increasingly stringent environmental regulations have and will continue to have a significant influence on fuel costs.

Power system use of natural gas and low-sulphur residual oil at some locations is predicated on environmental regulations.

The use of low sulphur Western Canadian bituminous coal, blended with U.S. coal, is predicated in part on meeting air quality regulations at existing stations without installing expensive and unproven scrubbing systems. However, this will raise the average

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combined fuel cost because Western Canadian bituminous coal delivered to Southern Ontario is substantially more expensive than coal from the U.S.

8.9.4 Availability - Effect on Fuel Cost

The most important factor affecting fuel costs in the long-run is physical availability. With increasing demand for fuels, incremental supplies will be obtained from resources which, as a general rule, will be higher cost than those already in production. Thus average unit fuel costs will continue to rise in real terms in the foreseeable future pending revolutionary technological breakthroughs in forms of energy production and use.

The cost of uranium supplies has also been escalating in concert with those of fossil fuels and is supported by an increasingly imbalanced supply/demand relationship as world uranium production capability fails to keep pace with planned nuclear capacity.

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8.10 REFERENCES

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8.11 OTHER RELATED DOCUMENTS

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